1042014 COMPLETE SPECIFICATION

2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 1

431/2

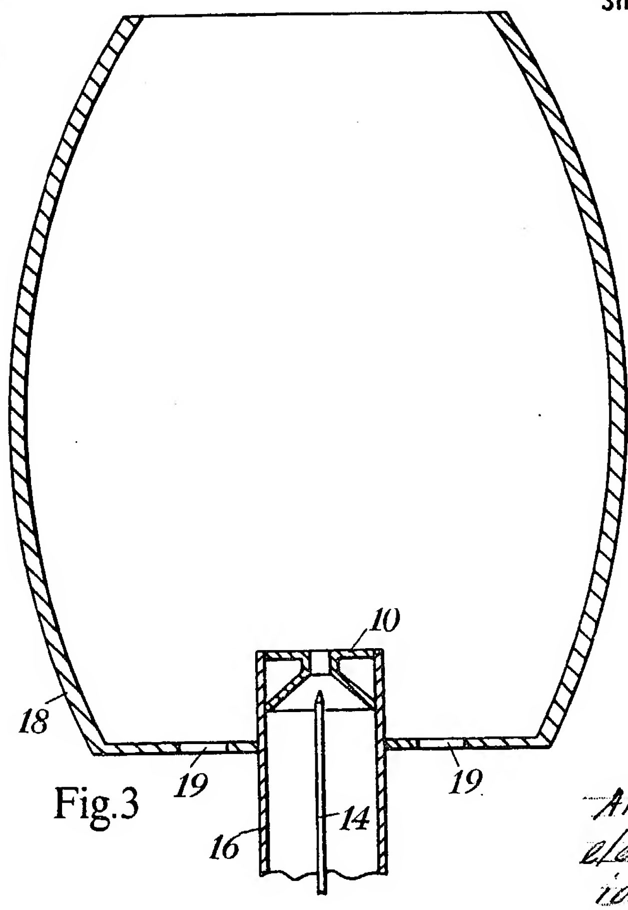

Fig.3

Arc maintained between electrodes to increase ionization

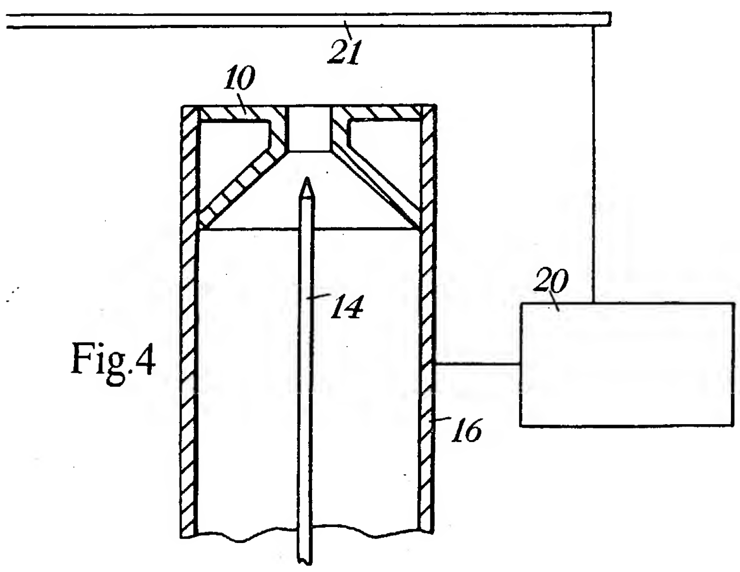

Fig.4

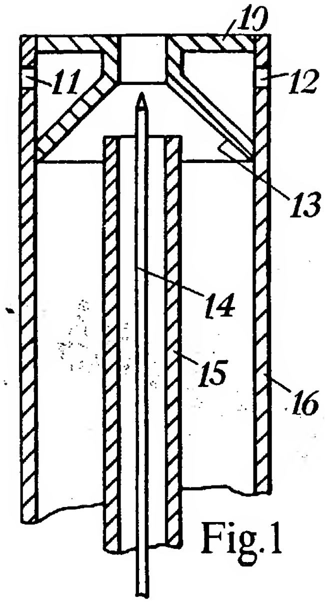

Fig.1

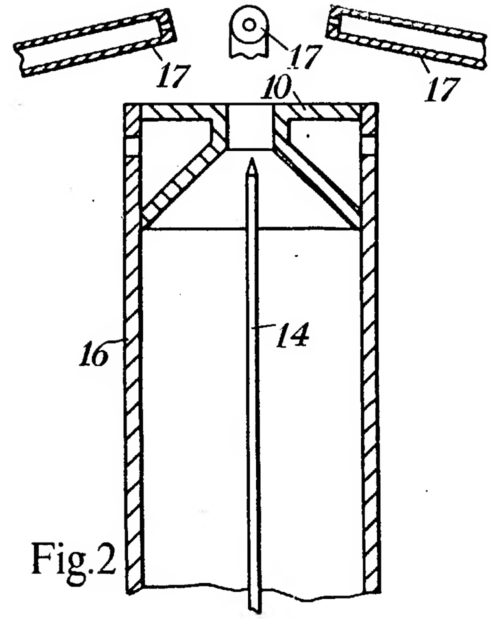

Fig.2

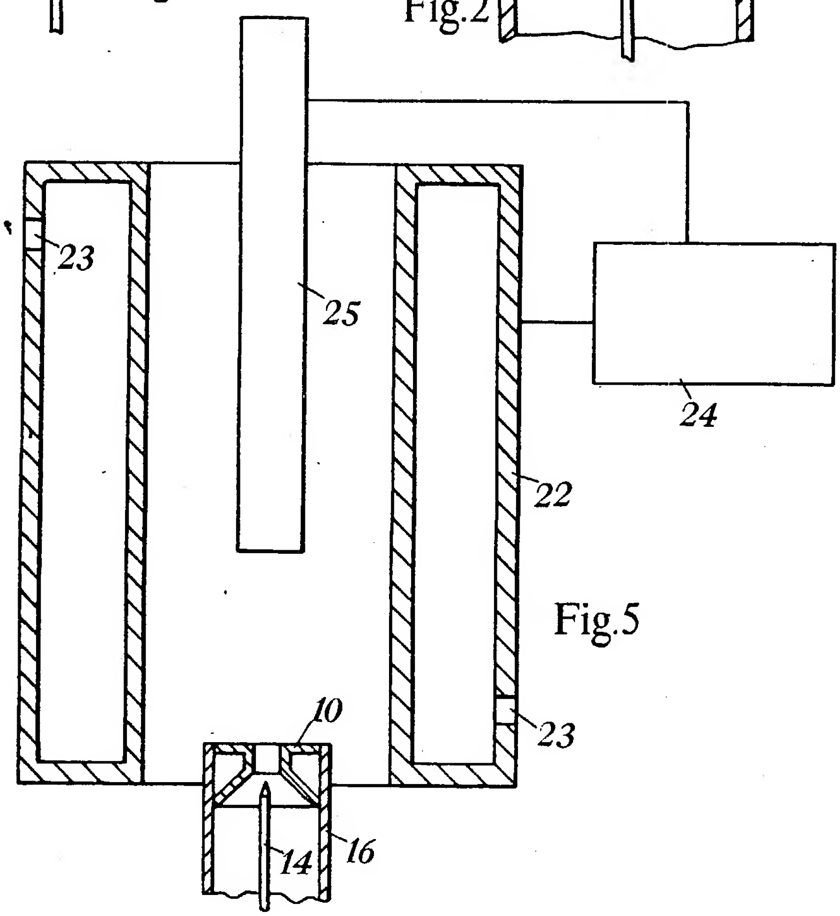

Fig.5

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Sheet 2

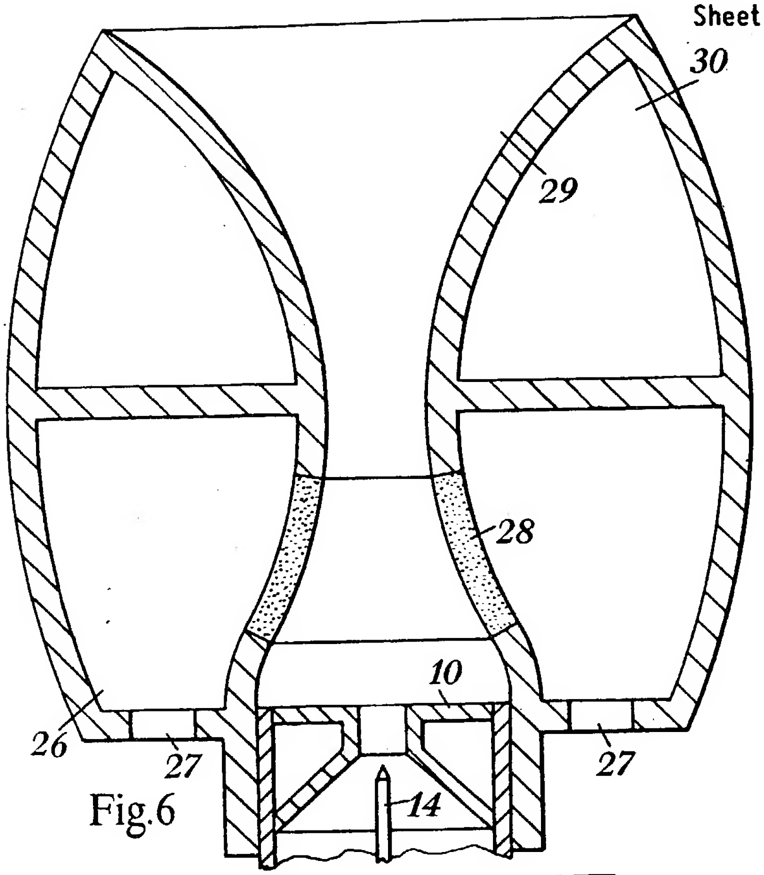

Fig.6

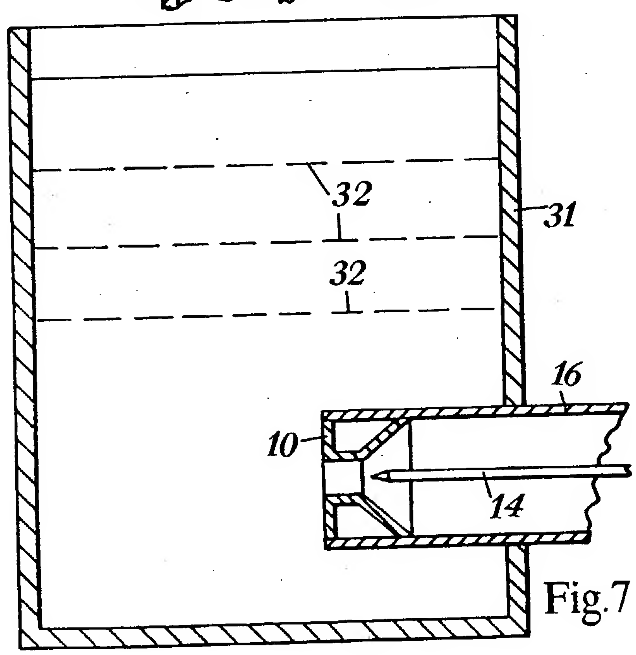

Fig.7

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PATENT SPECIFICATION

DRAWINGS ATTACHED

1,042,014

1,042,014

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Index at acceptance: —F4 F3; F1 B(2D1B, 2D1D)

Int. Cl.:—F 23 f//F 02 f

COMPLETE SPECIFICATION

A Fuel Burner

We, KENNETH PAYNE, of Plot A1., Road A, Hollies Farm Estate, Allestree, Derby, and FELIX JIRI WEINBERG, of 40 Hathaway Gardens, London W.13., both British Subjects, do hereby declare the invention for which we pray that a Patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to fuel burners and one of the objects of the invention is to provide a burner in which in use the temperature and degree of ionization of the flame issuing from the burner are substantially higher than those hitherto attainable from any given fuel.

A fuel burner in accordance with the invention includes a pair of co-axial electrodes, one of which is of annular form, together with one or more conduits for delivering a fuel-oxidant mixture to the region adjacent to the centre of said annular electrode, and means for striking and continuously maintaining an arc between the two electrodes to release electrical energy in the flame so as thereby to increase the temperature and degree of ionization thereof.

The annular electrode referred to may be made from copper or any other suitable material and is preferably of hollow configuration so as to permit of a cooling fluid being passed through its interior. The other electrode may be made from tungsten or thoriated tungsten or graphite or any other suitable material and may extend through a tubular shield through which an inert gas can be passed to protect said other electrode from attack by the hot gases.

There may be provided only one conduit for delivering the fuel-oxidant mixture to the region adjacent to the centre of said annular electrode, in which case the annular electrode may be connected on one side to a conduit which is co-axial with the other electrode and which is of larger diameter than the aforementioned tubular shield, the arrangement being such that said fuel-oxidant mixture flows along the annular space between said conduit and said shield to pass through the centre of the annular electrode whilst an arc is struck between the two electrodes.

Alternatively, the fuel-oxidant mixture may be delivered from a plurality of nozzles which are spaced circumferentially around the annular electrode, each nozzle extending in a direction transverse to the axis of said annular electrode and all the nozzles being arranged so as to produce in concert a flow which extends in a generally axial direction and which has an insignificant component of motion in a radial direction.

The relatively high temperature of the flame gases issuing from a burner in accordance with the invention also results in a relatively high degree of ionization of the flame gases and accordingly the invention also resides in a method of producing a flow of highly ionized flame gases which method comprises striking and continuously maintaining an electrical arc between a pair of co-axial electrodes in the flame formed by a burning fuel.

Such highly ionized gases can be used in various applications such as for example in the magneto-hydrodynamic generation of electricity from ionized gases; in controlling by electrical means the transfer of heat to surfaces of various kinds, and in gaseous electrolysis.

The invention will now be more particularly described with reference to the accompanying drawings wherein:—

Figure 1 is a diagrammatic fragmentary sectional elevation of one form of fuel burner in accordance with the invention,

Figure 2 is a similar view showing an alternative form of burner in accordance with the invention and

[Price 4s. 6d.]

Figures 3—7 are further diagrammatic fragmentary sectional elevations showing various alternative forms of apparatus incorporating a burner in accordance with the invention.

Referring firstly to Figure 1 there is provided an annular electrode 10 which is formed from a hollow ring of copper adapted to be connected via a port 11 to a supply of cooling fluid which will circulate through the ring before leaving via port 12. The central aperture of said annular electrode 10 is of cylindrical configuration at its downstream axial end and is of frusto-conical configuration as indicated by reference numeral 13 (the smaller diameter thereof being adjacent to the cylindrical portion) at its upstream axial end.

There is also provided ~~a further electrode~~ 14 in the form for example of a tungsten rod which is co-axially arranged with respect to said annular electrode and which extends at one end into the aforementioned frusto-conical portion of the central aperture of said annular electrode.

Extending around the tungsten rod 14 (which, in use, will be the cathode) is a tubular shield 15 through which in operation is passed a stream of inert gas (such as for example nitrogen or argon) to protect the cathode whilst to the downstream side of the annular electrode 10 (which, in use, will be the anode) is connected one end of a conduit 16 which is adapted to be connected to a supply of a fuel-oxidant mixture which may be in stoichiometric proportions, said shield 15 and said conduit 16 being co-axially disposed relative to the cathode. The fuel may, for example, be of gaseous form or it may be composed of solid particles (e.g. particles of carbon).

In use, the fuel-oxidant mixture is caused to flow at relatively high velocity into said conduit 16 through the central aperture of the annular anode 10 and an arc is struck between the anode and cathode by a high voltage discharge. The arc may thereafter be maintained at a low voltage of for example 20 volts. Combustion of the fuel takes place in the region around the centre of the annular anode and somewhat on the downstream side of said anode, flash-back into the burner being prevented by maintaining a high flow velocity of fuel-oxidant mixture through the burner and pre-ignition within said conduit 16 delivering the mixture being prevented by the flow of inert gas which forms a sheath over the hot surface of the cathode.

In an alternative construction (not shown) the rod cathode as above described is replaced by a cathode in the form of a bed of beads which may be constructed for example of tungsten or graphite chips, said bed being supported on a porous diaphragm extending across the end of the shielding tube along which will flow the inert gas as above described.

In the construction shown in Figures 2 inert gas only may be blown through the central aperture of the annular anode 10 around the cathode 14 and the fuel-oxidant mixture is delivered through a plurality of nozzles 17 disposed on the downstream side of the anode, each nozzle delivering a stream of said mixture in a direction which is inclined to the axis of the anode so that all the streams converge together to form a substantially axial flow with an insignificant component in the radial direction. As before, however, an arc is struck between the electrodes 10 and 14 to effect an electrical discharge, thereby increasing the temperature (and also the degree of ionization) of the flame. Alternatively, in the construction shown in Figure 2, one reactant may be introduced through the nozzles 17 and the other reactant through the interior of the conduit 16, the two reactants uniting on the downstream side of the annular anode 10.

In the example shown in Figure 3 the burner is associated with a combustion chamber 18 which assists in confining the combustion reaction and which is provided with a plurality of ports 19 through which in use the combustion reactants will flow. The annular anode 10, cathode 14 and conduit 16 are provided as before.

Figures 4 and 5 show examples in which a burner constructed in accordance with the present invention is used in apparatus in which means are provided to augment heat transfer to solid surfaces. In the example shown in Figure 4 a burner as shown in Fig. 2 has the conduit 16 connected to the positive side of a source of high electrical potential diagrammatically indicated by reference numeral 20, the negative side of which is connected to an object to be heated in the form of a flat plate 21, the reactants being introduced through the interior of the conduit 16. The ionized products of combustion will then be directed onto said plate 21. In the example shown in Figure 5 the burner (the reactants again being introduced through the interior of the conduit 16) is used in association with heat transfer apparatus which may for example be in the form of a boiler 22 having ports 23 for the passage of a fluid to which heat is to be transferred. In this example the negative side of a source of electrical potential 24 is connected to the boiler 22 whilst the positive side of said source is connected to a further anode 25, the anode 10 being connected as before so that in use an arc will be maintained between electrodes 10 and 14. An electrical field will thus be established which directs the ionized combustion products onto the interior annular surface of said boiler. On the other hand, if it is required to prevent the overheating of

an object which may for example be a combustion chamber or a part thereof, then said object would be connected to the positive side of said source of high electrical potential and the burner would be connected to the negative side.

In the arrangement shown in Figure 6 there is provided a burner having an annular anode and a cathode as before and in this case there is provided an annular chamber 26 having ports 27 through which a gaseous fuel-oxidant mixture can flow. Said chamber 26 has a porous or perforated inner wall section 28 through which the reactants can flow to the combustion zone just above the annular anode 10. The hot gas mixture then flows into a zone 29 in which rapid expansion occurs and thereby produces quenching. A further annular chamber 30 may also be provided through which a coolant fluid can be circulated. Such an apparatus can be used for the production of substances by the recombination of dissociated molecules consequent upon sudden quenching.

The arrangement shown in Figure 7 may also be used for a similar purpose although in this case the quenching is achieved by means of contact with water or other suitable liquid contained in a tank 31. Pieces of gauze 32 may be provided in the tank in order to break up bubbles in the liquid and in this case the reactants would be introduced through the interior of the conduit 16.

WHAT WE CLAIM IS:—

1. A fuel burner including a pair of co-axial electrodes, one of which is of annular form, together with one or more conduits for delivering a fuel-oxidant mixture to the region adjacent to the centre of said annular electrode, and means for striking and continuously maintaining an arc between the two electrodes to release electrical energy in the flame so as thereby to increase the temperature and degree of ionization thereof.

2. A fuel burner as claimed in claim 1 wherein said annular electrode is of hollow configuration so as to permit of a cooling fluid being passed through its interior.

3. A fuel burner as claimed in claim 1 or claim 2 wherein the other electrode extends through a tubular shield through which in use an inert gas can be passed to protect said other electrode from attack by hot gases.

4. A fuel burner as claimed in any one of the preceding claims wherein there is provided a conduit for carrying fuel-oxidant mixture to the region adjacent to the centre of the annular electrode, said conduit being co-axial with said other electrode and with the annular electrode.

5. A fuel burner as claimed in any one of claims 1—3 wherein there is provided a plurality of nozzles which are inclined to the axis of the annular electrode and which are arranged in use to carry fuel-oxidant mixture to the region adjacent to the centre of the annular electrode.

6. A fuel burner as claimed in any one of claims 1—3 in combination with a combustion chamber into which the fuel burner projects.

7. A fuel burner as claimed in any one of claims 1—3 in combination with a source of electrical potential which is arranged to be electrically connected in use so that its positive side is connected to the burner and its negative side is connected to an object to be heated or vice versa.

8. A fuel burner as claimed in any one of claims 1—3 in combination with means for cooling the flame gases.

9. A fuel burner as claimed in claim 8 wherein the cooling means comprises means for effecting a rapid expansion of the flame gases.

10. A fuel burner as claimed in claim 8 wherein the cooling means comprises a volume of liquid through which the flame gases are passed.

11. A method of producing a flow of highly ionized gases, said method comprising striking and continuously maintaining an electrical arc between a pair of co-axial electrodes in the flame formed by a burning fuel.

12. A fuel burner substantially as hereinbefore described with reference to and as shown in Figure 1 or Figure 2 of the accompanying drawings.

13. A fuel burner in combination with apparatus substantially as hereinbefore described with reference to and as shown in Figure 3 or Figure 4 or Figure 5 or Figure 6 or Figure 7 of the accompanying drawings.

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